PREFACE
The Evolution of Human-Building Interaction: An HCI Perspective

Human-Building Interaction (HBI) consists in the study and design of interactive opportunities for the occupants to shape the physical, spatial, and social product of their built environments [1]. The vision for this nascent field is to become a self-evolving design research practice that brings together knowledge from the domains of *a)* Human-Computer Interaction, and particularly Interaction Design, *b)* Ubiquitous Computing, and *c)* Architecture and Urban Design. The ultimate objective is to answer questions that embody the complexity of our interactive experiences with and within the built environments of today and the ones of future. A wide span of such questions have reemerged in the recent HCI and architecture discourses. This may be, in part, due to the evolving world of the so-called "Internet of Things", but also to the maturity of intelligent, interactive architectural elements that are now available in the toolbox of building and urban designers. An example set of HBI questions, each uniquely contextualized, are addressed in this special issue. The first paper asks: through what methods HBI researchers can uncover the occupants' mental model of different spaces in a built environment (with focus on learning spaces)? The second paper discusses the opportunities and challenges for the deformable user interfaces to integrate into the future interior design (with focus on domestic environments)? The third paper's question is: how can design interventions modify the social dynamics in urban spaces (with focus on bus stops)? And the fourth paper asks about the relevance of networking infrastructure in the practice of architectural design (with focus on workplaces)?

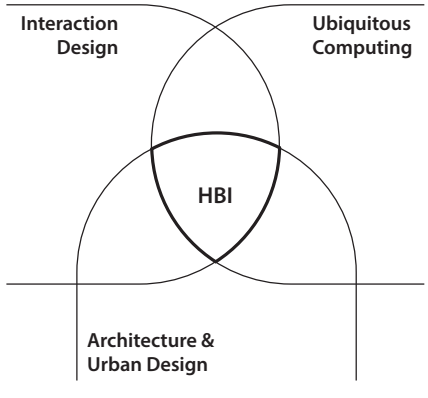

Fig. 1. Human-Building Interaction (HBI) as a research domain situates itself at the intersection of Architecture and urban Design, Interaction Design, and Ubicomp

The three facets of "building" - physical, spatial, and social - underpin the HBI definition proposed above. This is inspired by Bill Hillier's suggestion that "building"

is a construction of physical elements that creates and protects a space, while each of these two aspects - the physical and the spatial - carry a social value [2]. The scope of the ideas that HBI is intended to capture, however, has to be evolved in symbiosis with the ongoing research instances in this field. In the following we try to offer an initial framing for the scope of HBI in relation to some of the neighbouring concepts:

Building vs. Built Environment: the properties of "building" that are interesting for HBI discussions are also recognisable in "public and urban spaces", and thus the scope of HBI can be pushed from only private or semi-private buildings to include other types of built environments such as public spaces and even passenger-carrying vehicular spaces (e.g. train, airplane, car).

Building vs. Collection of Artifacts: built environments may appear as collection of object artifacts, and thus HBI may be seen merely as the analysis of human interaction with a set of spatially configured physical artifacts. We argue that this is far from the whole story; buildings are especially appealing for HBI studies because they create and shape *our* space and offer "spatio-temporally immersive" experiences that vary principally from the user experience of artifacts.

Building vs. Home: the home and domestic experiences have been widely investigated in recent HCI studies. Even though there are research questions and methodologies that are common between HBI and particular genres of "HCI in Home" [3] , we argue that the difference between these two domains, at root, is a conceptual one. At the core of the concept of building is a *body* that generates meaningful spaces, whereas home is a *situation* with certain practices and social routines.

The methodologies that HBI can inherit from the contributing domains cover a wide range, from quantitative analysis of building performance, to living labs, to field-testing, and to observational methodologies such as ethnography of human interaction with artifact and space. The introduction of new design instances in ecologically valid settings entails usability evaluations via populated observational studies, which in turn facilitates the creation of *intermediate-level knowledge* such as patterns, guidelines, and strong concepts [4]. Particularly, this knowledge may serve a dual purpose of informing researchers about the effectiveness of these design instances, as well as contribute to the *generalized framework* of HBI. The presented papers in this special issue contribute to the advancement of HBI methodologies by identifying the research tools that can be combined and re-appropriated for the HBI problem in hand. Moreover, they present design instances and develop intermediary bodies of HBI knowledge by discussing the effectiveness of a population of design interventions that embody similar interaction techniques.

The first paper, by Carine Lallemand and Vincent Koenig, showcases the transfer of a research method from HCI to the study and design of learning spaces. The paper offers a structured review of the literature that aim at constructing criteria for effective learning spaces, concluding that even though it is established that the physical spaces can have impact on individual learning and group formation, the nuances of such influence are yet unexplored and require more contextualized experimentations. The presented study - following Repertory Grid method - produces a classification of concepts and vocabulary of how the learners describe different spatial and social settings. Such method for understanding the learners' mental model of their school, the authors argue, can support design and assessment of HBI in learning space.

In the second paper presented in this special issue, Sara Nebil, David S. Kirk, Thomas Ploetz, and Peter Wright discuss the potentials of interfaces that can dynamically change form, color, and texture, in the design of future interiors. The authors argue that such Organic User Interfaces (OUI), owing to the increasingly available deformable sensors, pneumatic actuators, and shape-memory alloys, are becoming an important part of the vision of physical computing. The paper then narrows down its focus to the application of OUIs in interior design and discusses the opportunities that they can offer to the HBI designers as well as the challenges that are yet to be addresses, for example, in terms of ethics, reliability, and sustained user engagement.

The third paper, by Mahdis Aliasgari and Brendon Clark, examines the interventions that can support and shape the dialogue between people and designed public environments and among people themselves supported by the designed space. Mahdis and Brendon demonstrate the results of two "breaching experiments" in bus stations in the city of Stockholm, which they crafted to examine the possibilities of igniting social interactions in "non-places".

In the fourth paper, Human-Building Interaction is addressed from a different standpoint. Selena Savic takes our attention to the elements of smart homes and smart cities: responsiveness, sensitivity, and connectivity, and then explores the meanings of "connectivity" outside of its functional paradigm. Can connectivity be a material to be designed and interacted with? With examples, she explains her answer to this question and supports it with presenting an approach in designing space that is sensitive to wireless networking infrastructure.

At the end we would like to recall that HBI, in its current state, is a nascent concept, nurturing which entails the creation of an interdisciplinary forum that ignite mutual learning and project-based collaborations. This has been our main objective for organising CHI'16 workshop on "Future of Human-Building Interaction", to which this special issue is a sampling of complementing works: three out of the four presented papers are the developed revisions of the CHI'16 workshop papers.

We aspire to support the HBI forum to grow into a research community in which researchers from the different relevant fields contribute to and influence each other's research work. In this regard, one can see three possible approaches: (1) the interaction designers and ubicomp researchers enhance the functional aspects of architectural spaces by designing, furnishing, and evaluating interactive tools and artifacts for these spaces; (2) the architects incorporate interactive technologies off-the-shelf into their design process, and finally (3) the architects and HCI researchers can work in tandem from the pre-design phase to create ad-hoc interactive built environments. While the third approach brings evident advantages over the first two (e.g. being able to functionally and structurally metamorphosize depending on the emergent requirements of the inhabitant, group or a community), it requires creating common groundings and making compatible the architecture and technology design processes. This, we believe, is the critical challenge that HBI should strive to address in its near future agenda

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